THE additions to the Zoological Society's Gardens during the past week include a Patas Monkey (*Cercopithecus patas*) from West Africa, presented by Mr. U. R. Noble; two Bonnet Monkeys (*Macacus sinicus*) from India, presented respectively by Mrs. Noble and Miss Weil; two Ring-tailed Coatis (*Nasua rufa*) from South America, presented respectively by Mr. Charles North and Mr. E. F. Johnston; two White-tailed Gnus (*Connochaetes gnu*) from South Africa, presented by Mr. C. D. Rudd; an Osprey (*Pandion haliaetus*) captured at sea, presented by Commander H. Strong; a Toco Toucan (*Ramphastos toco*) from Guiana, a Red-billed Toucan (*Ramphastos erythrorhynchus*) from Cayenne, a Hutchin's Goose (*Bernicla hutchinsi*) from Arctic America, presented by H.E. Sir W. J. Sendall, G.C.M.G.; two Infernal Snakes (*Boodon infernalis*), six Rufescent Snakes (*Leptodira hotambaeia*), six Rhomb-marked Snakes (*Trimerorhinus rhombeatus*), five Crossed Snakes (*Psammophis crucifer*), two Rough-keeled Snakes (*Dasypeltis scabra*) from South Africa, presented by Mr. A. W. Guthrie; a Horned Lizard (*Phrynosoma cornutum*) from Texas, presented by Miss Wilson; an Eyed Lizard (*Lacerta ocellata*), a Tessellated Snake (*Tropidonotus tessellatus*), South European, presented by the Rev. F. J. Jervis-Smith, F.R.S.; a Brindled Gnu (*Connochaetes taurina*) from East Africa, purchased.

OUR ASTRONOMICAL COLUMN.

NOVA PERSEI.—A telegram from Kiel announces that photographs of Nova Persei, taken on August 19 and 20 by MM. Flammarion and Antoniadi, show a nebulous aureola having a definite sharp outline.

PERIOD OF MIRA CETI.—Prof. A. A. Nijland finds from a series of thirty-nine observations of this long-period variable during the interval July 17 to September 11, 1900, that the maximum occurred last year on August 3. As will be seen from the table below, this brings the period back to the short value of 1897. (*Astronomische Nachrichten*, Bd. 156, No. 3733.)

Observed maximum.	Predicted (Chandler III.).	Magnitude.	Period.
1897 Jan. 11	1896 Dec. 12	3·70	
			319 days
1897 Nov. 26	1897 Nov. 9	3·24	
			312
1898 Oct. 4	1898 Oct. 6	2·91	
			350
1899 Sept. 19	1899 Sept. 3	3·75	
			318
1900 Aug. 3	1900 Aug. 1	3·35	

THE CAPE OBSERVATORY.—The annual report to the Admiralty has recently been issued by Sir David Gill, and summarises the work done at the institution during the year 1900.

The new transit observatory is now satisfactorily erected. It is of sheet steel, having triple sides, thus forming a double series of ventilating shafts, arranged so as to carry off all heated air by convection and deliver it by funnels 13 feet distant from the observing shutter; this latter is 6 feet wide, formed by the two halves of the building sliding apart.

The upper part of the structure is semicylindrical, its axis coinciding with that of the transit circle. It is hoped that this symmetry between building and instrument will eliminate abnormal refractions. The double-chambered walls have made it possible to attain practical equality between the external and internal temperatures.

Transit Circle.—Much of the transit circle work has consisted of a thorough investigation of the influence of "star magnitude" on the observers' personal equations. The results are given in detail, and indicate that, while there is considerable range in magnitude personality for different observers, every observer records the time of transit of a faint star later than that of a bright one, and also, as a rule, this personality is greater "per magnitude" for faint than for bright stars. Another somewhat unexpected fact brought out by the investigation is that the difference of personality remains nearly the same for stars of very different declination.

Heliometer.—Regular observations of all oppositions of major planets have been continued—of these fifty-three related to Jupiter, forty to Saturn, forty-four to Uranus and sixty-six to Neptune. Observations were also made of the conjunction of Jupiter and β Scorpii, and of the distances of the cusps of the partially eclipsed sun on November 22, 1900.

McClean Equatorial.—The 24-inch photographic objective has been refigured and forwarded to the Cape from Dublin. The 18-inch visual telescope has been employed in the observation of double stars, thirty-one previously unrecorded pairs being found, nine of which are naked-eye stars.

In consequence of the absorption of the three heavy flint prisms belonging to the "line of sight," spectrograph they have been replaced by four of lighter glass giving the same total deviation. Mr. McClean, who is providing these, has also generously given an order to Messrs. Zeiss for a second objective prism of 24 inches aperture and 10° refracting angle.

Physical Laboratory.—Investigations have been in progress by Mr. Lunt dealing with the spectra of oxygen, silicon, aluminium, boron and sulphur, and provision is being made for a further study of the spectra of various gases.

Astrographic Charts and Catalogue.—One hundred and three triple image chart plates have been passed, bringing up the total to 362. For the revision catalogue, 172 plates have been taken. During the year, 124 catalogue plates, containing 71,655 stars, have been completely measured in both coordinates in reversed positions of plate.

South African Survey.—This has been pushed rapidly forward in Rhodesia, the party reaching latitude 16° 30′ S., and they expected to reach the Zambesi by the end of July. The operations for the Anglo-German Boundary Survey are also in steady progress. It is hoped that arrangements will soon be possible for the extension of the survey through the international territories north of Rhodesia, thus bringing the long-wished-for African arc of meridian nearer to practical realisation.

OBSERVATION OF COMET *a* (1901).—Mr. J. Cresswell, writing from a mining camp near the centre of Borneo, sends a drawing of this comet, which was visible there on May 7–12. He says:—"It was very bright, and had two tails which on May 10 were 29½° apart and on May 12 35° apart. The lower tail was less bright than the upper. I looked for it during the solar eclipse, but did not see it." Further observations were prevented by cloud.

THE AUGUST METEORS OF 1901.

THE weather was tolerably clear near the time of the maximum and enabled the shower to be pretty well observed. On August 10, 11 and 12, or on one or two of those nights, a considerable number of meteors were recorded at various places where the clearness of the sky permitted observation. The maximum appears to have occurred rather later than usual, for the greatest number of meteors displayed themselves on Tuesday morning, August 13, but the state of the sky did not allow the progress of the display to be fully observed during its rise, culmination and fall.

The first marked indication of the Perseids as a definite shower became apparent on July 21, when the writer at Bristol recorded five swift streak-leaving meteors from a radiant at 23°+52°, but two of them were imperfectly seen and their directions could be only roughly noted, so that the resulting radiant was not very satisfactory, though there could be no doubt of its actual existence either at or very near to the position assigned.

Between July 21 and August 10 the development of the shower could not be fully traced, owing to moonlight or cloudy weather. On August 10 the display was moderately rich. There was no special activity on the part of the Perseids, but the minor showers of the period were in prominent evidence and provided meteors as fast as the observer found it convenient to record them. Between about 9h. 30m. and 15h. the total number of meteors seen by the writer at Bristol was 102, but nearly half of the time mentioned was consumed in registering paths. While the observer's attention was, in this manner, diverted from the sky, a large number of meteors must have eluded notice; of the 102 seen 55 were Perseids.

On August 11 the sky was clear until after midnight, and

between 9h. 30m. and 12h. 30m., 72 meteors were noticed, of which 49 were Perseids. As compared with the previous night the Perseids had increased, while the other meteors exhibited a marked decrease. Clouds prevented further observation at 12h. 30m.

On August 12 the sky was overcast, but between 14h. and 14h. 30m. there was a break along the east and south-east horizon, through which a few of the stars could be seen. Meteors were numerous, and it was considered that with a clear sky the display would have been unusually fine.

A few cloudy nights intervened, but on August 15 and 16 observations were secured during clear intervals. The Perseid shower was still actively in play, and supplied about one-third of the aggregate number of meteors visible. On August 18 the sky was watched between 9h. 30m. and 14h. 15m., but meteors, generally, were extremely rare. The Perseid shower furnished eight paths, so that the display was still well defined. On August 19, observations were made between 9h. 30m. and 15h., and 40 meteors were seen, of which 3 only were Perseids, so that the stream had become nearly exhausted. The radiant point was determined from several well-observed paths on each night, and its easterly position as compared with its place on August 10 and 11 was strikingly evident. Between July 21 and August 18, its R.A. differed to the extent of 32°, as the following figures will prove :—

July 21	...	23°+52°	...	5 meteors
Aug. 10	...	44+58	...	55 ,,
11	...	45+58	...	49 ,,
15	...	51+58	...	6 ,,
16	...	53+58	...	5 ,,
18	...	55+59	...	8 ,,

The Perseids furnished some brilliant specimens, but there was only one fireball seen by the writer. This appeared at 11h. 2m. on August 11, and lit up the south-eastern sky with a lightning-like flash. It was seen also at Birmingham and Yeovil, and its height is given in the table. The largest meteors recorded at Bristol were as below :—

		h.	m.		From		To		
Aug. 10	...	12	47	♃	331½°+6½°	...	324½°− 6½°	...	swift stk.
	...	13	0	♃	33 −4	...	32 −12	...	v. swift stk.
	...	13	17½	>♃	333 +60	...	302 +45½	...	v. swift stk.
	...	13	33	1	62 +22½	...	66 +11¼	...	v. v. slow.
Aug. 11	...	11	2	2×♀	353½+ 7	...	343 −14	...	v. swift stk.
	...	11	34	♃	43 +79	...	232 +73	...	sw. b. stk.
	...	11	56	♀	120 +74	...	160 +65	...	sw. stk.
	12	14	4	♃	46 − 5	...	46 −15	...	sw. stk.
	19	14	5	♃	322 +48½	...	338½+41	...	v. slow train.

Four meteors seen on August 10 were also recorded by Prof. A. S. Herschel at Slough, and their real paths have been determined. Their heights, &c., are included in the following table, in which are also given the results for the fireball of August 11, which left a streak for about a minute amongst the stars of Aquarius. It must have been a magnificent object from the English Channel :—

	h.	m.	mags.	Height at first miles.	Height at end miles.	Path miles.	Velocity per sec. miles.	Radiant
Aug. 10 ...	10	41	3−2	91	72	20	24	278°+67°
	12	0	1	76	51	36	50	44+58½
	12	16	2−1	69	50	27	39	42+57
	12	19	3−2	72	60	33	25	149+60
Aug. 11 ...	11	2	2×♀	95	56	64	...	45+58

The latter object began over the channel at a point about 25 miles W. of Dieppe, and ended a little W. of Havre on the French coast. It would be interesting to hear further descriptions of it from the channel and from the north region of France.

Reports are coming in from various observers, and show that the display was quite up to, if it did not exceed, the average. Mr. D. E. Packer, writing from Birmingham, says :—"On Saturday night, August 10, several hundreds of meteors were observed here in a four-hours' watch, commencing at 10 p.m. On Sunday, August 11, during the same period of time the number nearly reached a thousand. At 11 p.m. a magnificent fireball burst over the southern part of the sky, lighting up the heavens with a full moon radiance and leaving a brilliant streak of light which persisted for some little time." A correspondent of the *Nottingham Daily Guardian* says :—"On August 10 we had a splendid display of the meteors. The night proved to be the brightest and clearest I ever remember to have seen, and at about 10 o'clock meteors in great numbers were to be seen flitting across the heavens from north-east to south-west. On Sunday night, August 11, the display was repeated with even greater brilliance and frequency and with more variation, the sky being again very clear."

These descriptions may possibly convey a somewhat exaggerated idea of the character of the shower this year, but they sufficiently prove that the event was a conspicuous one and well worth the attention given to it.

As observed at Bristol the radiant point was pretty definite, for an area of about 3 degrees would include very nearly all the tracks directed from it on August 10 and 11. With reference to the minor showers, there were a considerable number visible, though they were very feeble. A few degrees south of the head of Draco and at the point 269° + 47°, there was a radiant of bright-trained, slow-moving meteors, while east of ζ Persei at 63°+30° there was a radiant of very swift streak-leaving meteors. There were other well defined showers from 290°+53°, 312°+13° and 333°+72°. W. F. DENNING.

Mr. W. E. Rolston sends the following account of observations made by him :—

"I commenced my observations at Birmingham at 10.45 p.m. on the night of August 11 and continued them till 12.48 a.m. on the morning of August 12, when a bank of clouds rising from the N.E. stopped further observations. For this period, of 2 hours 3 minutes, I counted 143 meteors, which appeared to have their origin in the region of Perseus, and 17 others having various origins. During this time a very clear sky obtained, rendering short and faint trails easily visible. All the observations were visual, and, as I happened to have exhausted my stock of plates, I was unable to attempt the securing of "trail" photographs. Several of the Perseids were remarkable either for their brightness, or else for the length of time their trails were visible after the nucleus had either disappeared below my horizon—of surrounding houses—or had died away. Observations on these, including the times of their appearance, are given in the appended table.

"From the 143 observations made, I deduced that the radiant point of these meteors is situated about the point whose co-ordinates are :—Decl. 58° N., R.A. 2h. 35m.

G.M.T. of appearance. h.	m.	Remarks.
11	7	Remarkable for a very bright nucleus, and a vivid trail which remained visible *for* 53–55 *seconds;* first appeared in the region of κ Andromedæ (alt. about 60°), and travelled between Aquila and Delphinus to about alt. 25°, when it disappeared behind a housetop. The trail had a bluish-white and shimmering appearance.
11	14	Appeared in region of δ Cassiopiæ ; was very bright, and trail lasted for 7 seconds.
11	35	Appeared in region of δ Cygni and travelled through Lyra, leaving a bright trail which lasted for 9 seconds.
11	53	Appeared in region of α Persei and travelled towards Aries ; was very short, but very bright ; evidently the greater component of its motion was in the line of sight.
11	55	Appeared in region of 33 Cygni and travelled S.W. through Lyra ; very bright, and left a bright trail which lasted about 8 seconds.
12	5	Very bright and short ; left bright trail which was, as nearly as I could judge, exactly parallel to a line joining β and γ Arietis, and near to them.
12	10	Very bright, leaving a good trail from Cassiopeia, half way between β Pegasi and ε Cygni.
12	15	A very bright meteor which "occulted" α Andromedæ and then travelled in the direction of the group 59, 57 and 55 Pegasi.

"In addition to the above, I remarked one of the extra 17—not a Perseid—which at 11.27 appeared at about the middle of The Great Square and travelled right through the zenith, disappearing near Corona and leaving behind it a remarkable red shimmering trail which lasted for 4 or 5 seconds.

"The above times given for the duration of trails were obtained by counting seconds from judgment, not by a watch. The observations were made whilst lying on my back, so that nearly the whole of the sky above the available horizon was observed."

SAND WAVES IN TIDAL CURRENTS.[1]

THE sand waves dealt with in this paper are not the well-known "current mark," or ripple mark of rivers, but the larger sort, first scientifically described by Prof. Osborne Reynolds. These larger sand waves are the normal production of a swift current when adequately supplied with sand. The supposed condition of "uniform drift" (the current picking up as much sand as it drops, and therefore neither silting nor scouring) is really so unstable that, when the current becomes sufficiently swift to hold sand in eddying suspension. it passes almost suddenly into wave motion, uniform drift being replaced by alternate silt and scour, giving ridges and furrows of sand which travel down stream. The material of the ridges is constantly being picked up by the current from the weather slopes, and deposited upon the lee slopes. Some explanation of the process was given in NATURE (vol. lxiii. p. 623, April 25) in the abstract of another paper by the author;[2] this is further elaborated in the paper now before us, which contains also details of the observations and measurements carried out during the year 1900, which have not hitherto been published.

The amplitude of the tidal sand waves is obviously limited by the depth of water, and it follows that as the tide ebbs off sand-banks, it tends to obliterate the ridges, leaving the banks with the smoothed surface which is familiar. Sometimes pools are left below the general level of the smoothed surface (Fig. 1). These have a steep and a gentle side, the former the lee slope of one ridge, the latter the weather slope of the next ridge. They are, in fact, homologous with the pits, called Fuljes, in sandy deserts.

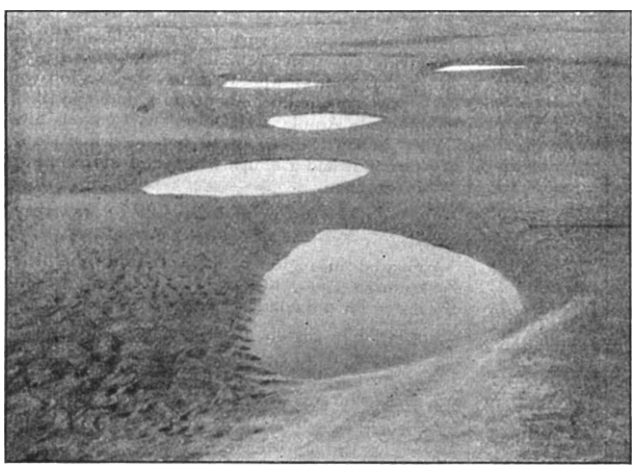

FIG. 1.—A chain of pools, Annat Sand, Montrose.

Where the conditions are such that the tide covers and leaves the banks gently, though running strongly when the water is deep upon them, the banks dry out with their wave surface almost perfectly preserved. The required conditions were found by the author in the tidal basins with narrow entrances at Barmouth and Aberdovey, North Wales, at Findhorn and Montrose, N.B., and at the Dun Sands, on the Severn (Fig. 2), which are protected from the tide until well submerged by a rocky shoal, which juts out from the left bank of the river.

The observed wave-length or distance from ridge to ridge varied from 3 feet 6 inches to 54 feet. The smallest of these measurements was unusual. From 12 to 24 feet wave-lengths were common. The steepest ridges had a wave-length 13·39 times as great as their height. In the model estuaries of Prof. Osborne Reynolds the wave-length was twelve times the amplitude.

FIG. 2.—Interpenetrating ridges on the Dun Sands.

Fig. 3 shows the orderly march of the ridges upon a portion of a sand-bank in the estuary of the Dovey, which the author pegged out for purposes of measurement with stakes driven into the sand to a depth of about 3 feet. There were five transverse rows of stakes 15 feet from row to row, and in each transverse row the distance from stake to stake was 20 feet. This permitted the exact measurement of the position of five wave-fronts along four sections. String stretched from stake to stake at the two sides of the plot served as datum lines and enabled amplitude and mean-sand-level to be taken with tolerable accuracy along two sections. Measurements were made once a day when the sands were dry. From June 2 to 5, 1900, the tides were diminishing after springs, and the average amplitude of the ridges diminished from 6″·34 to 3″·71 with no perceptible change of mean sand-level. The average wave-length in the same time only diminished from 14′ 3″·7 to 13′ 6″·6, and the regularity of the wave-lengths improved, thus:—

	Per cent. of mean L.
On June 1, av. diff. of successive Ls.	= 13·4
,, 2 ,, ,,	= 11·4
,, 3 ,, ,,	= 10·7
,, 4 ,, ,,	= 4·4
,, 5 ,, ,,	= 6·6

On June 5 the tidal current appeared to have fallen below some critical velocity, and suddenly to have lost control of the wave system. This is shown by the following table of the average advance of the ridges, which was:—

From June 1 to June 2 ...	38″·07
,, ,, 2 ,, ,, 3 ...	29″·75
,, ,, 3 ,, ,, 4 ...	30″·57
,, ,, 4 ,, ,, 5 ...	1″·4

During neap tides the sands of the plot were almost smooth, and such undulations as could be seen on the surface were irregular and ill-defined. During the subsequent increase of tides, however, the plot emerged one day all covered with sharply defined ridges, which grew daily in height, and also (by elimination of some of the ridges) in length. On June 15 the average amplitude was 9″·71, with an average wave-length of 11′ 9″. The increase of wave-length appears to take place by the obliteration of certain ridges which find themselves unfavourably placed owing to the too great growth of the ridge on

[1] Abstract of a paper by Dr. Vaughan Cornish, read before the Royal Geographical Society, June 10, and published in the *Geographical Journal*, August 1901.

[2] "On the Formation of Wave-surfaces in Sand," *Scottish Geographical Magazine*, vol. xvii., January 1901.